

Remarks

Claims 1-37 were pending in the subject application. By way of Amendment, claim 4 has been amended to correct a typographical error. Accordingly, claims 1-37 are currently before the Examiner. Favorable consideration of the pending claims is respectfully requested.

The abstract of the subject disclosure has been objected to because it is more than 150 words. The Abstract has been amended and is now less than 150 words. Accordingly, the applicant respectfully requests reconsideration and removal of the objection to the abstract.

The drawings have been objected to because they do not include reference sign(s). The applicant has herewith submitted copies of Figures 2, 3, 7, 8, and 9, with the proposed amendments to add reference sign(s) shown in red. The specification has also been amended to incorporate these proposed reference sign(s). The applicant believes the amended drawings show every feature of the invention specified in the claims. Accordingly, the applicant respectfully requests reconsideration and removal of the objection to the drawings.

The disclosure has been objected to on page 3 of the Office Action due to the following informality: at page 4, line 9, the phrase “x-ray source can capable ...” is not clear. The applicant thanks the Examiner for his careful reading of the subject specification. Page 4, line 9 of the specification has been amended to now read “x-ray source capable ...”. Accordingly, the applicant respectfully requests reconsideration and removal of objection to the disclosure.

Claims 1-20 and 37 have been rejected under 35 USC §112, second paragraph. The applicants respectfully traverse this grounds for rejection. In particular, one skilled in the art having the benefit of the subject disclosure would understand what is claimed. The Office Action states “Claim 1, it is unclear as to the waveguide comprising a first end a second end since in claim 4, it refers to the first tapered cylinder is coupled to the first end of the waveguide and in claim 5, it indicates that the x-ray irradiation exiting the second end of the waveguide is incident on the reflecting tip”; “there is no clear understanding of the first and second ends as shown in the drawings; and “it is also unclear as to what the means for directing the x-ray irradiation is the applicant referring to”.

Claim 1 is directed to an apparatus for delivery of x-ray irradiation to a target, comprising: a waveguide for transporting x-ray irradiation, the waveguide comprising a first end and second end; a means for coupling x-ray irradiation into the first end of the waveguide, wherein the means for ...

comprises a first tapered cylinder; and a means for directing the x-ray irradiation exiting the second end of the waveguide to a target. Figure 8 shows a waveguide (hollow waveguide) having a first end and second end, a means for coupling x-ray irradiation into the first end of the waveguide (collector-homogenizer), and a means for directing the x-ray irradiation exiting the second end of the waveguide to a target (irradiating tip). Figure 2 shows a tapered cylinder receiving an x-ray beam into the wide end of the tapered cylinder and x-ray irradiation exiting the narrow end of the tapered cylinder for coupling into a waveguide (see, for example, page 14, lines 8-10). Figure 3 shows a tapered cylinder coupling x-ray irradiation from an x-ray source into an end of a waveguide (see, for example, page 8, line 25 through page 9, line 9). Figure 9 shows x-ray irradiation exiting the end of a waveguide (hollow waveguide) and being directed to a target (arteria) (see, for example, page 9, lines 17-27). Accordingly, as taught by the Figures and specification, the first end of the waveguide of the invention of claim 1 receives x-ray irradiation from the means for coupling x-ray irradiation into the first end of the waveguide and the x-ray irradiation exiting the second end of the waveguide is directed to the target by the means for directing the x-ray irradiation exiting the second end of the waveguide to a target.

Claim 4 depends from claim 3 which depends from claim 1. Claim 3 includes the limitation “wherein the first tapered cylinder is a hollow cylinder”. Support for this limitation can be found at, at least, Figures 2 and 3. Claim 4 includes the limitation “wherein the first tapered cylinder reduces the cross-sectional area of the x-ray irradiation entering the first tapered cylinder as the x-ray irradiation traverses the first tapered cylinder, and the x-ray irradiation is coupled into the first end of the waveguide”. Accordingly, with respect to the invention claimed in claim 4, x-ray irradiation enters the first tapered cylinder, the cross-sectional area of the x-ray irradiation is reduced as the x-ray irradiation traverses the first tapered cylinder, and the x-ray irradiation is coupled into the first end of the waveguide.

Claim 5 depends from claim 3 and includes the limitation “wherein the means for directing the x-ray irradiation exiting the second end of the waveguide to a target comprises a reflecting tip such that the x-ray irradiation exiting the second end of the waveguide is incident on the reflecting tip and is reflected by the reflecting tip to the target.”

Claim 16 depends from claim 5 and includes the limitation “further comprising: a means for receiving x-ray irradiation exiting the second end of the waveguide and outputting the x-ray

irradiation such that the outputted x-ray irradiation is incident on the reflecting tip”. Support for this limitation can be found at least at Figure 9 and page 9, lines 17-27, among other locations of the specification. As shown in Figure 9, one embodiment of the subject invention incorporates a hollow taper to receive x-ray irradiation exiting the second end of the waveguide and outputs the x-ray irradiation such that the outputted x-ray irradiation is incident on the reflecting tip, as described at page 9, lines 17-27.

Claim 17 depends from claim 16 and includes the limitation “wherein the means for receiving ... is a second tapered cylinder. Support for this limitation can be found at least at Figure 9 and page 9, lines 17-27 of the specification.

Claim 37 depends from claim 31 and includes the limitation “wherein an x-ray irradiation beam exiting the distal end of the waveguide is coupled into a second tapered cylinder, ...”. Support for this limitation can be found at least at Figure 9 and page 9, lines 17-27 of the specification.

The applicants believe claims 1-20 and 37 particularly point out and distinctly claim the subject matter which the applicants regard as the invention. Accordingly, the applicants respectfully request reconsideration and withdrawal of the rejections of claim 1-20 and 37 under 35 U.S.C. §112.

Claims 1-37 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Thiel (U.S. Patent No. 5,101,422) in view of Loxley (US Patent No. 6,504,901). The applicants respectfully traverse this ground for rejection. The Office Action states that “Thiel teaches, an apparatus and method for delivering x-ray irradiation to a target comprising a means for generating x-ray irradiation (80), a hollow waveguide (22) having a first end and a second end, a means for coupling (10), in form of a tapered hollow cylinder, x-ray irradiation into the first end of the waveguide and a means for directing (14) the x-ray irradiation exiting the second end of the waveguide to a target”. However, plastic material (22) is not a waveguide for transporting x-ray irradiation and capillary (10) does not couple x-ray irradiation into the first end of a waveguide. Rather, referring to column 4, lines 8-23, plastic material (22) is applied to the outer layer of the capillary (10) ... to give it strength and flexibility. Furthermore, small end (14) is not a means for directing x-ray irradiation exiting a second end of a waveguide to a target, but is just the end of capillary (10). The Office Action acknowledges that “Thiel does not explicitly teach the waveguide” and states “however, the capillary is surrounded by the guiding element (22), which could be a waveguide as claimed”. There is no indication that plastic material (22) could be a waveguide for

transporting x-ray irradiation, nor any indication of how capillary (10) can couple x-ray irradiation into the first end of a plastic coating (22) on the outer surface of the capillary (1) itself. Rather, Thiel teaches a mounting for an x-ray capillary where the capillary is “coated by a plastic material (22) ... to protect the thin glass wall of the capillary” (see column 4, lines 9-13).

The Office Action states “Thiel teaches the tip of the tapered cylinder to be a reflecting tube and made from glass (column 3, lines 34-37)”. The applicants assume this statement is made with respect to claim 5, which includes the limitation “wherein the means for directing the x-ray irradiation exiting the second end of the waveguide to a target comprises a reflecting tip”. As shown in Figure 9 and described at, at least, page 9, lines 17-27, a reflecting tip in accordance with the subject invention reflects x-ray irradiation exiting the second end of the waveguide which is incident on the reflecting tip. In contrast, tip of the tapered cylinder (14) in Thiel is not a reflecting tip as described in the subject application, but, rather, is just the end of the capillary (see column 3, line 55).

The Office Action states that the applicant has not thoroughly described the use of a second portion of glass having different index of refraction than the first glass portion. The specification, at page 9, line 27, has been amended to add the description of the reflecting tip from claim 6.

The Office Action states “as to the second cylinder Loxley teaches the use of plurality of tapered cylinders”. The applicants assume this statement is referring to claim 17. Claim 17 depends from claim 16 which depends from claim 5. Claim 16 includes the limitation “further comprising: a means for receiving x-ray irradiation exiting the second end of the waveguide ... ” and claim 17 includes the limitation “wherein the means for receiving x-ray radiation exiting the second end of the waveguide. . . is a second tapered cylinder.” Accordingly, the second tapered cylinder of the subject invention as claimed in claim 17 receives x-ray irradiation exiting the second end of the waveguide and outputs the x-ray irradiation such that the outputted x-ray irradiation is incident on the reflecting tip, where the first tapered cylinder couples x-ray irradiation into the first end of the waveguide. In contrast, the Loxley *et al.* reference teaches a “capillary waveguide comprises one or more tapered capillaries ... ” where the capillary waveguide can have a plurality of tapered capillaries in parallel (see column 2, lines 6-9; column 6, lines 24-26; Figure 6; and Figure 7). Accordingly, instead of a first tapered cylinder coupling x-ray irradiation into a waveguide and x-ray irradiation exiting the waveguide coupling into a second tapered cylinder as claimed in claim 17 of the subject application,

where each of the first and second tapered cylinders of the subject invention perform different functions, the capillaries or channels of the Loxley *et al.* reference are in parallel and, therefore, each perform the same function.

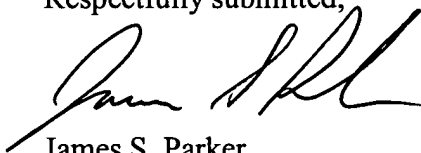
Accordingly, as the Thiel reference and the Loxley *et al.*, either alone or in combination, do not teach an apparatus for delivery of x-ray irradiation to a target, having: a waveguide for transporting x-ray irradiation, the waveguide comprising a first end and second end; a means for coupling x-ray irradiation into the first end of the waveguide, wherein the means for coupling x-ray irradiation into the first end of the waveguide comprises a first tapered cylinder; and a means for directing the x-ray irradiation exiting the second end of the waveguide to a target, the applicants assert that a *prima facie* case of obviousness has not been presented. Accordingly, the applicant respectfully requests reconsideration and withdrawal of this rejection under 35 U.S.C. §103(a).

In view of the foregoing remarks and the amendment above, the applicant believes that the currently pending claims are in condition for allowance, and such action is respectfully requested.

The Commissioner is hereby authorized to charge any fees under 37 CFR §§1.16 or 1.17 as required by this paper to Deposit Account No. 19-0065.

The applicant also invites the Examiner to call the undersigned if clarification is needed on any of this response, or if the Examiner believes a telephone interview would expedite the prosecution of the subject application to completion.

Respectfully submitted,



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- Attachments:
1. Red-line amended Figures 2, 3, 7, 8, 9 (three pages)
  2. New Formal Figures 1-10 with amendments incorporated (seven pages)
  3. Information Disclosure Statement with authorization to charge Deposit Account.
  4. Form PTO-1449 with copies of listed references.